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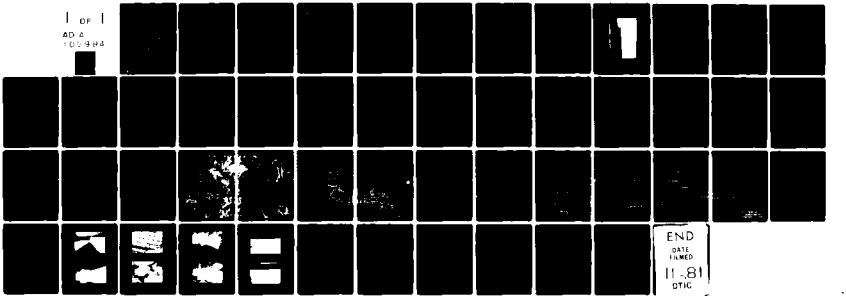

MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

MELODY LAKE DAM
FRANKLIN COUNTY, MISSOURI
MO 30547

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

DECEMBER 1978

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This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Melody Lake Dam Phase I Inspection Report

This report presents the results of a field inspection and an evaluation of the Melody Lake Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SIGNED

SUBMITTED BY: _____ 28 DEC 1978
Chief, Engineering Division — Date

SIGNED

APPROVED BY: _____ 28 DEC 1978
Colonel, CE, District Engineer — Date

MELODY LAKE DAM
FRANKLIN COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30547

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

HORNER & SHIFRIN, INC.
5200 OAKLAND AVENUE
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FOR:

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS

DECEMBER 1978

HS-7848-10

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Melody Lake Dam
State Located:	Missouri
County Located:	Franklin
Stream:	Tributary Bourbeuse River
Inspection Dates:	21 August 1978, 27 October 1978

The Melody Lake Dam was visually inspected by engineering personnel of the office of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of the inspection was to assess the general condition of the dam with respect to safety and, based upon this inspection and available data, determine if the dam poses a hazard to human life or property.

The following summarizes the findings of the inspection and the results of certain hydrologic/hydraulic investigations performed under the direction of the inspection team.

Based on a visual inspection, the present general physical condition of the dam and spillway is considered satisfactory; however, the following deficiencies were noticed during the inspection and are considered to have an adverse effect on the overall safety and future operation of the dam and spillway:

1. A moderately dense cover of brush that may contain animal burrows and numerous small trees are present on the downstream face of the dam. Tree roots and animal burrows can provide passageways for seepage that could develop into a piping condition and subsequent failure of the dam. Some seepage, as is evidenced by cattails and wet ground, was noticed at the toe of the downstream slope near the left and right abutments. Water believed to be seepage was also observed flowing into the lagoon at the toe of slope near the right abutment.

2. Several small trees also exist on the upstream face of the dam. Roots of these trees can also contribute to seepage that could develop into a piping condition.

3. Some erosion of the subgrade at the outlet end of the 12-inch diameter pipe through the dam has occurred and a water-filled pool has been created at this point. The possibility exists that continued erosion may backcut the downstream face of the dam, resulting in settlement of the slope and/or instability of the embankment. Due to the proximity of the sewage treatment lagoon, the earthfill dike for the lagoon could similarly be affected.

4. Dense growth in the channel can effect a reduction of the carrying capacity of the stream and cause local flooding. This in turn will cause a reduction in the capacity of the 12-inch outlet of the drop inlet spillway structure.

5. At the time of the inspection it appeared that the sanitary sewer passing beneath the dam could not be isolated if necessary in order to prevent loss of foundation soils, should collapse of the sewer beneath the dam occur. Also, the size or type of pipe used for this section of sewer could not be determined. Voids resulting from loss of materials into the pipe may cause settlement of the embankment above the pipe.

The conditions described above are not considered to be serious at this time.

The low section in the top of the dam at the right abutment will function as an emergency spillway for lake outflow and it is assumed that it was meant to be that. However, due to terracing of the hillside downstream of the crest (presumably for agricultural purposes), the outlet channel for this spillway is not readily discernible. According to survey data obtained during the inspection, the channel was found to follow the contour of the hillside. Earth from terracing the hill creates a bank on the left (looking downstream)

side of the channel and serves to confine the flow within the channel. Discharge will be maintained within the channel until the depth of flow exceeds the height of the bank at which point spill down the hillside will occur.

According to the criteria set forth in the recommended guidelines (see text) the minimum spillway design flood for this dam, which is classified as intermediate in size and of high hazard potential, is specified to be the Probable Maximum flood (PMF). PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Results of a hydrologic/hydraulic analysis indicate that the existing spillways (drop inlet and emergency) are inadequate to pass lake outflow resulting from a storm of PMF magnitude without overtopping the dam. They are adequate to pass lake outflow resulting from the 1 percent chance (100-year frequency) flood. The existing drop inlet and emergency spillways are capable of passing lake outflow corresponding to about 47 percent of the PMF. The length of the downstream damage zone, should failure of the dam occur, is estimated to be five miles. Within the damage zone are three to four houses. There is one gravel road across the dam.

A review of available data did not disclose that seepage and stability analyses of the dam were performed. This is considered a deficiency and should be rectified.

It is recommended that the Owner take the necessary action in the near future to correct or control the deficiencies and safety defects reported herein.

Albert B. Becker, Jr.

Albert B. Becker, Jr.
P.E. Missouri E-9168

OVERVIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MELODY LAKE DAM - ID NO. 30547

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MELODY LAKE DAM - ID NO. 30547

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. National Dam Inspection Act, Public Law 92-367, dated 8 August 1972.

b. Purpose of Inspection. The purpose of this visual inspection was to make an assessment of the general conditions of the dam with respect to safety and, based upon available data and visual inspection, determine if the dam and spillway pose a hazard to human life or property.

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as prescribed in "Recommended Guidelines for Safety Inspection of Dams," Appendix D to "Report of the Chief of Engineers on the National Program of Dams," dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Melody Lake Dam is an earthfill type embankment rising approximately 53 feet above the original streambed. Lake level is governed by the overflow elevation of a drop inlet type spillway located near the center of the dam on the upstream side. A 12-inch diameter pipe that passes through the dam serves as an outlet for the drop inlet spillway. The spillway outlet channel joins the Bourbeuse River approximately 2,000 feet below the dam. An emergency spillway consisting of an unpaved dish-shaped broad-crested section is located at the right abutment. The hillside to which the dam abuts evidently had been terraced for farming prior to the creation of the lake and the outlet channel for the emergency spillway follows a course along one of the terraces. The channel which originates as a flat trapezoidal section gradually merges into the hillside and is

barely discernible at its terminus. Spillway flow is confined until the depth of flow within the channel exceeds the bank height and spills down the hillside. Lake outflow is unregulated. A gravel surfaced road traverses the top of the dam and the emergency spillway crest. A 10-foot wide berm is located about 22 feet below the top of the dam on the downstream side of the embankment. The downstream slope is 1v on 2.0h above the berm and 1v on 2.3h below the berm. The upstream slope is 1v on 2.2h above the waterline. Riprap serves to protect the upstream slope of the dam from erosion. A sewage treatment lagoon about 4 acres in surface area is located adjacent to the downstream toe of slope. A sanitary sewer line reportedly passes beneath the dam and discharges flow to the lagoon. There are no drawdown facilities for dewatering the lake.

b. Location. The dam and lake are located on an unnamed tributary of the Bourbeuse River, approximately 5 miles south of Leslie, Missouri, in Franklin County, as shown on the Regional Vicinity Map, Plate 1. The dam is located in Section 27, Township 42 North, Range 3 West, within the subdivision known as Melody Lake.

c. Size Classification. The size classification, based on the height of the dam and storage capacity, is categorized as intermediate. (Per Table 1, Recommended Guidelines for Safety Inspection of Dams.)

d. Hazard Classification. According to the St. Louis District, Corps of Engineers, the Melody Lake Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, serious damage to homes, extensive agricultural, industrial and commercial facilities, public utilities, main highways, or railroads. The estimated flood damage zone, should failure of the dam occur, as determined by the St. Louis District, extends five miles downstream of the dam. Within the possible damage zone are three to four homes. The floodplain of the Bourbeuse River below Melody Lake is extensively farmed. There are no river crossings in the damage zone, nor any industrial or commercial facilities. There is one gravel road across the dam.

e. Ownership. The dam is owned by Melody Lake, Inc., a subdivision association. The current president of the association is Mr. Harold E. Horsley,

Jr. His business address is 24 Stonegate Center, Valley Park, Missouri, 63088.

f. Purpose of Dam. The dam impounds water for the purpose of recreation by property owners of Melody Lake Subdivision.

g. Design and Construction History. The dam was constructed in about 1964 for Dr. & Mrs. Norman F. Rathert, Mr. & Mrs. Fred C. Engelhardt, and Mr. & Mrs. Robert M. Webb, the original developers of Melody Lake Subdivision. In 1972, as a result of a law suit brought forth by a group of lot owners within the subdivision against the developers, the plaintiffs were awarded the unsold subdivision property including the lake, dam, streets, and all other common ground. Shortly after the settlement, Melody Lake Inc. was formed and in 1973 the property was officially deeded to the corporation. The present status and location of Mr. and Mrs. Engelhardt are unknown. Dr. Rathert and Mr. Webb are deceased and the status and location of their spouses are unknown. The parties responsible for the design and construction of the dam are unknown.

h. Normal Operational Procedure. The lake level is regulated by the overflow elevation of a drop inlet type spillway.

1.3 PERTINENT DATA

a. Drainage Area. The area tributary to the lake is primarily suburban residential around the perimeter of the lake and the remaining area is largely covered by forest. The watershed above the dam amounts to approximately 243 acres. The watershed area is outlined on Plate 1.

b. Discharge at Damsite.

(1) Estimated known maximum flood at damsite ... 6 cfs(1)

(2) Drop inlet spillway capacity ... 17 cfs (W.S. elev. 693.0)

(3) Drop inlet plus emergency spillway capacity ... 380 cfs (W.S. elev. 694.6)

(1) Value computed for water surface at elevation 689.5 and based upon an estimate of maximum depth of flow over the drop inlet spillway as supplied by a resident living adjacent to the lake. Date of observed flow unknown. (Based on the size of the watershed, it is more than likely that lake outflow greater than that reported has occurred.)

c. Elevation (ft. above MSL). The top of the drop inlet spillway, located near the center of the dam on the upstream side, was assumed to be elevation 689 (feet above MSL); the basis for this assumption being the elevation for the lake surface and considered to be the normal pool level shown on the 1966 Strain, Missouri, Quadrangle Map, 7.5 minute series.

(1) Top of dam ... 694.6 (min.)
(2) Normal pool (top of drop inlet spillway) ... 689.0
(3) Streambed at centerline of dam ... 642±
(4) Maximum tailwater ... Unknown
(5) Water level in lagoon ... 651.7

d. Reservoir.
(1) Length of normal pool (elevation 689.0) ... 2,400 ft.
(2) Length of maximum pool (elevation 694.6) ... 2,600 ft.

e. Storage.
(1) Normal pool ... 510 ac.ft.
(2) Top of dam (incremental) ... 220 ac.ft.

f. Reservoir Surface.
(1) Top of dam ... 42 acres
(2) Normal pool ... 35 acres

g. Dam.
(1) Type ... Earthfill
(2) Length ... 1,070 ft.
(3) Height ... 53 ft.
(4) Top width ... 13 ft.
(5) Side slopes
    a. Upstream ... 1v on 2.2h
    b. Downstream ... 1v on 2.0h (upper), 1v on 2.3h (lower)(1)
(6) Cutoff ... Unknown
(7) Core ... Unknown

(1) 10-foot wide berm at elevation 672.4±.

(8) Slope protection

a. Upstream ... Grass and riprap

b. Downstream ... Grass

h. Principal Spillway.

(1) Type ... Drop inlet

(2) Size ... 18" riser pipe, 12" outlet pipe

(3) Crest ... Elevation 689.0

(4) Invert at outlet ... Elevation 642.8

i. Emergency Spillway.

(1) Type ... Excavated earth, broad-crested dish-shaped section

(2) Crest ... Elevation 693.0

(3) Width (top) ... 100 ft. (+)

j. Outlet for Lake Drawdown ... None provided.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No engineering data relating to the design of the dam are known to exist.

2.2 CONSTRUCTION

No records relating to the construction of the dam are known to exist.

According to information furnished by Dr. J. Hadley Williams of the Missouri Geological Survey, and based on observations made while visiting the site in the winter when the dam was under construction, large volumes of frozen earth were placed in the dam. On a subsequent visit, Dr. Williams reported that the backslope of the dam had settled so much (due likely to thawing of the frozen fill) that the pipe line to the sewage lagoon was sheared and that the displacement of the pipe was on the order of 6 inches. The line was later repaired and remains in the dam. Dr. Williams also reports that the dam structure rests on the Roubidoux Sandstone formation.

According to information contained in "An Introduction to Missouri's Geological Environment," as prepared by the Missouri Geological Survey and Water Resources, the soil most likely used to construct the dam was a stoney, red clay. Examination of exposed soil adjacent to the downstream toe of slope near the left abutment indicated the material at this location to be a slightly clayey silt containing very fine sand.

2.3 OPERATION

The lake level is governed by an uncontrolled, drop inlet type spillway. The estimated maximum known loading on the dam, according to a long-term resident living adjacent to the lake, was a storm that produced a depth of flow at the drop inlet spillway crest of about 6 inches.

2.4 EVALUATION

a. Availability. Engineering data for assessing the design of the earthfill dam and spillway were unavailable.

b. Adequacy. No data available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the dam was made by Horner & Shifrin engineering personnel on 21 August 1978 and on 27 October 1978. Also inspected was the readily accessible area downstream of the dam for a distance of about five miles. Participating in these inspections were: R. E. Sauthoff, Civil Engineer and Hydrologist; D. L. Heideman, Civil Engineer; A. B. Becker, Jr., Civil and Soils Engineer. Photographs of the dam taken at the time of the inspections are included on Pages A-1 through A-4 of the Appendix.

b. Dam. The visible portions of the upstream and downstream faces of the dam (see Photos 1 and 2) appeared to be in sound condition, although numerous trees and brush exist on the downstream side. Seepage, as evidenced by wet ground, cattails (see Photo 6) and flowing water, was noticed adjacent to the downstream toe of slope near the right abutment. Seepage was also noticed at the downstream toe of slope in an area between the left abutment and the spillway outlet pipe. Limestone riprap, ranging in size from 2 inches to pieces estimated to weigh about 200 pounds, serves to protect the upstream face of the dam above and below the normal waterline. A road with a gravel surface traverses the top of the dam crossing the crest of the emergency spillway. No cracking of the exposed ground surface at the crest was noticed. A profile along the top of the dam extending through the crest of the emergency spillway is shown on Plate 3. Examination of the top of dam profile indicates a difference of approximately 0.6-foot between low and high elevations. It is probable that settlement, due to thawing and subsequent consolidation of frozen fill (see discussion in paragraph 2.2), could account for the irregular level of the top of the dam.

A sewage treatment lagoon (see Photos 2 and 4) is located immediately below the dam and on the right bank of the downstream channel. The lagoon (approximately 4 acres in surface area) and earthfill dikes on the north, east, and south sides appeared to be in satisfactory condition. There was no

evidence of manholes on the lagoon influent line in the vicinity of the dam at the time of inspection.

c. Drop Inlet Spillway. The 18-inch diameter steel pipe riser section for the drop inlet type spillway (see Photo 3), located near the center of the dam, appeared to be in good condition. A steel bar trash screen serves to protect the opening from clogging by debris. The screen also appeared to be in good condition. On the day of inspection, the lake level was approximately 2 - 3 inches below the top of the riser. The growth of grass around the riser indicates that the normal pool level has not been maintained for some period prior to the inspection. The visible part of the end of the 12-inch diameter steel pipe outlet for the drop inlet spillway appeared to be in satisfactory condition, although it did have a coating of rust. A profile of the drop inlet spillway is shown on Plate 4. The profile of the 12-inch line is assumed based upon the invert elevations measured at the upper and lower ends of the pipe. The channel subgrade at the 12-inch pipe outlet was eroded and filled with water (see Photo 5). Several medium-size willow trees were growing in the channel in the vicinity of the outlet pipe (see Photo 4). The downstream channel below the outlet pipe is unimproved and joins the Bourbeuse River approximately 2,000 feet below the dam. The channel lies adjacent to the lagoon dike for a distance of about 600 feet.

d. Emergency Spillway. The emergency spillway located at the right abutment appeared to be in satisfactory condition, although some erosion of the unprotected bank (see Photo 7) on the lake side was noticed. The outlet channel follows the contour of the hillside along one of the terraces of the hillside (see Photo 8). The terraced hillside extends beyond the watershed boundary. A low embankment that serves as the confining bank on the left side of the terrace intersects the dam adjacent to the spillway crest. The bank and channel bottom are grass-covered and are used for pasture. A profile of the emergency spillway channel is shown on Plate 4.

e. Reservoir. The area contiguous to the lake was found to be in satisfactory condition with the shoreline grass and trees well maintained. According

to a resident living adjacent to the lake, a considerable amount of sediment is present in the upstream end of the lake.

3.2 EVALUATION

The deficiencies observed during the inspection are not considered of major consequence to warrant immediate remedial action.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillway is uncontrolled. The water surface level is governed by rainfall runoff, evaporation, seepage, and the capacities of the drop inlet and emergency spillways.

4.2 MAINTENANCE OF DAM AND SPILLWAY

Based on the substantial cover of small trees and vegetation on the downstream slope of the dam, it is apparent that this area receives little attention. Cattails growing in wet areas immediately below the dam also indicate lack of concern for seepage problems and drainage of these areas. According to a representative of the Owner, the grass on the upstream face of the dam is mowed occasionally during the growing season.

4.3 MAINTENANCE OF OUTLET OPERATING FACILITIES

No outlet operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEMS IN EFFECT

The inspection did not reveal the existence of a dam warning system.

4.5 EVALUATION

A poorly maintained dam is considered detrimental to the safety of the dam. It is recommended that maintenance of all areas of the dam be undertaken on a regular basis.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data are not available.

b. Experience Data. The drainage area and lake surface area were obtained from the USGS Strain, Missouri, Quadrangle Map. The proportions and dimensions of the spillways and dam were developed from surveys made during the inspection.

c. Visual Observations.

(1) The 18-inch diameter drop inlet spillway and 12-inch outlet pipe, located near the center of the dam, are in satisfactory condition.

(2) The emergency spillway and outlet channel are located in the right abutment. The outlet channel follows the contours of a terraced hillside. Spillway releases within the capacity of the spillway will not endanger the integrity of the dam.

d. Overtopping Potential. The spillways are inadequate to pass the probable maximum flood but nearly adequate for the 1/2 probable maximum flood without overtopping the dam. They are adequate to pass the 1 percent chance (100-year frequency) flood. The results of a dam overtopping analysis are as follows:

Ratio of PMF	Q - Peak Outflow (cfs)	Max. Lake Water Surface Elev.	Max. Depth of Flow Over Dam (Elev. 694.6)	Duration of Overtopping of Dam (Hours)
0.47	380	694.6	0	0
0.50	440	694.7	0.1	2.1
1.0	4,120	695.7	1.1	4.6
100-Year Flood	15	691.9	0	0

The flow safely passing the spillways (drop inlet plus emergency) just prior to overtopping amounts to about 380 cfs, which is equivalent to about 47 percent of the probable maximum flood, and exceeds the 1 percent chance (100-year frequency) flood. The flow passing the drop inlet spillway just prior to the lake surface reaching the invert of the emergency spillway amounts to 17 cfs.

Under PMF conditions, with a duration of flow overtopping the dam of 4.6 hours and a maximum depth of flow of 1.1 feet, it is possible that significant erosion of the downstream face of the dam could occur, particularly if the dam is composed of soil containing large quantities of sandy silt. Sandy, silt type soil materials were observed at the time of the inspection at the downstream toe of slope near the left abutment.

Procedures and data for determining the probable maximum flood, the 100-year frequency flood, and the discharge rating curve for flow over the spillway and the dam crest are presented on Pages B-1 and B-2 of the Appendix. A listing of the HEC-1 (Dam Safety Version) input data is shown on Pages B-3 through B-5 of the Appendix. A copy of the computer output table entitled "Summary of Dam Safety Analysis" is presented on Page B-6 of the Appendix.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. Visual observations which adversely affect the structural stability of the dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. No design or construction data relating to the structural stability nor seepage and stability analyses of the dam are known to exist.

c. Operating Records. No appurtenant structures or facilities requiring operation exist at this dam. According to a representative of the Owner, no records have been kept of lake level, spillway discharge, dam settlement, or seepage.

d. Post Construction Changes. According to a representative of the Owner, no post construction changes have been made. Reportedly, the sewage treatment lagoon located immediately below the dam, including the sewer passing beneath the embankment, was constructed at the same time as the dam.

e. Seismic Stability. Since the dam is located within a Zone II seismic probability area, an earthquake of the magnitude predicted is not expected to produce a hazardous condition to the dam, provided that static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several items were noticed during the visual inspection that adversely affect the safety of the dam. These items, which exist on the downstream slope, are seepage, trees, and dense brush. The extent of the effect of these items can be better assessed after the trees and brush are removed.

A hydraulic analysis indicated the drop inlet and emergency spillways to be capable of passing lake outflow of about 380 cfs without the level of the lake exceeding the low point of the dam. A similar analysis indicated the drop inlet spillway to be capable of passing lake outflow of about 17 cfs without the level of the lake exceeding the invert of the emergency spillway. A hydrologic analysis of the lake watershed area, as discussed in Section 5, indicated that for storm runoff of probable maximum flood magnitude the lake outflow would be on the order of 4,120 cfs, and for the 100-year frequency flood the lake outflow would be about 15 cfs.

No stability and seepage analyses of the dam or hydraulic analyses of the spillways are known to exist.

b. Adequacy of Information. Due to the lack of engineering and construction data, the assessments reported herein were based on external conditions as determined during the visual inspection. The assessment of the hydrology of the watershed and capacity of the spillways were based on a hydrologic/hydraulic study as indicated in Section 5. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. The items concerning the safety of the dam noted in paragraph 7.1a and the remedial measures recommended in paragraph 7.2 should be accomplished in the near future.

d. Necessity for Phase II. Based on the results of the Phase I inspection, a Phase II investigation is not recommended.

e. Seismic Stability. Since the dam is located within a Zone II seismic probability area, an earthquake of the magnitude predicted is not expected to produce a hazardous condition to the dam, provided that static stability conditions are satisfactory and conventional safety margins exist.

7.2 REMEDIAL MEASURES

a. Recommendations. The following actions are recommended:

(1) Based upon the criteria set forth in the recommended guidelines, alterations to the design of the dam should be made in order to pass lake outflow resulting from a storm of probable maximum flood magnitude. In any event, the emergency spillway should be protected to prevent erosion.

(2) Obtain the necessary soil data and perform stability and seepage analyses in order to determine the structural stability of the dam for all operational conditions. The lagoon adjacent to the dam should be considered in these analyses. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of dams.

(3) An investigation did not reveal the kind of pipe material or type of joints used for the sanitary sewer passing beneath the dam. Further, it could not be determined if collars were constructed about the pipe beneath the dam to provide obstruction to seepage flow. Also, there appears to be no provision on the upstream side of the dam for isolating the sanitary sewer should failure or other problems occur in the sewer beneath the dam. The Owner should address these matters and take the necessary corrective measures.

b. Operation and Maintenance (O & M) Procedures. The following O & M procedures are recommended:

(1) Remove the trees and brush that may conceal animal burrows from the downstream face of the dam. Holes from tree roots and voids created by animal burrows provide passageways for seepage that can lead to a piping condition and potential failure. The turf cover should be restored if destroyed or missing. Maintain the turf cover on the slope at a height that will not hinder inspection of the slope.

(2) Once the downstream slope is cleared of trees and brush, it should be thoroughly checked for seepage, erosion and other signs of instability. If excessive seepage flows are observed or sloughing noted, the dam should be investigated by an engineer experienced in design and construction of dams.

(3) Provide some means of preventing piping due to seepage at the downstream face of the dam. A piping condition could result in failure of the dam. Also, seepage flow should be drained in order to prevent saturation of the soil adjacent to the embankment, which is a condition considered detrimental to the structural stability of the dam.

(4) Provide some form of surface protection for the roadway crossing the emergency spillway in order to prevent erosion of the section during periods of lake outflow at this location.

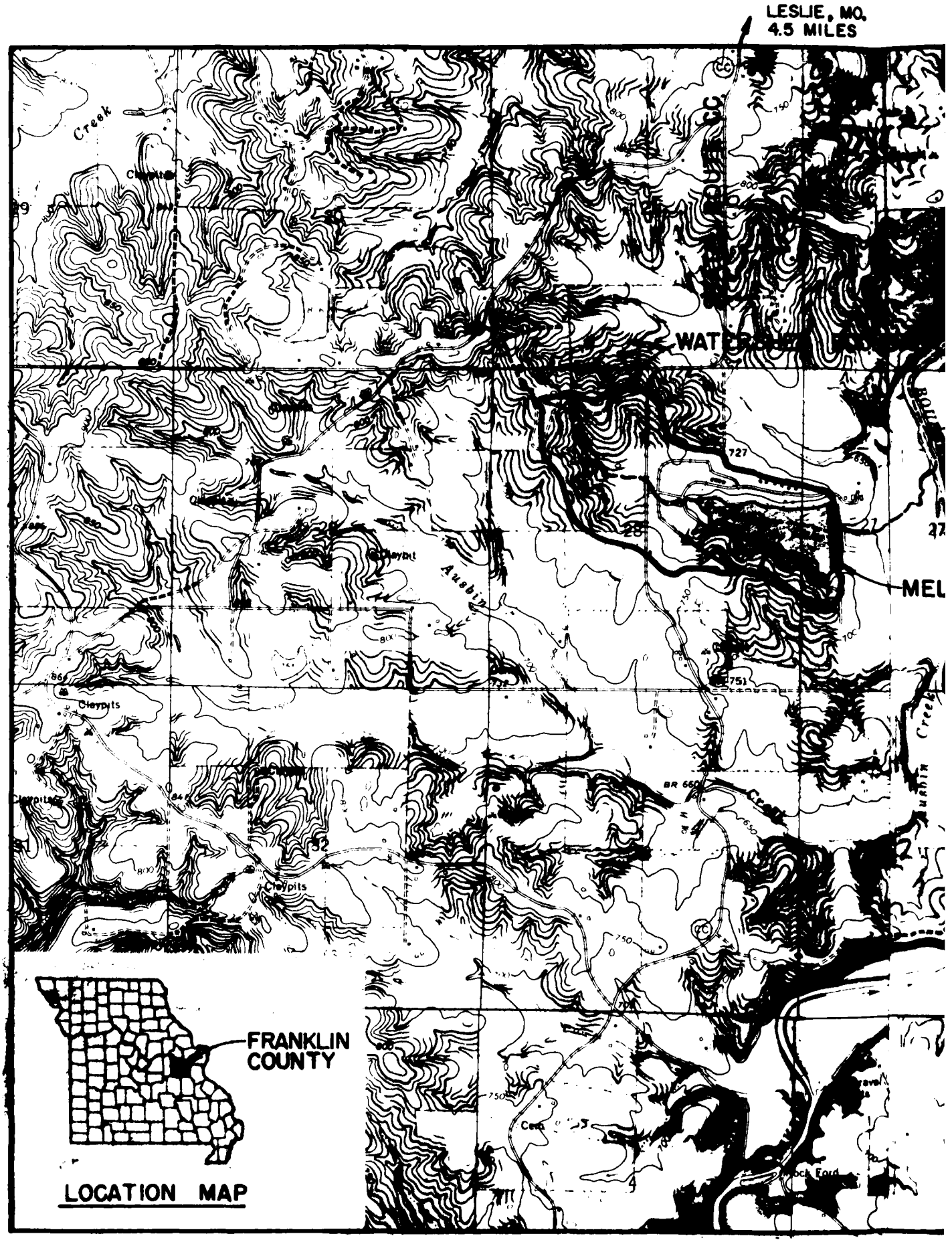
(5) Provide some form of slope protection for the upstream face of the emergency spillway at and above the normal waterline in order to prevent erosion by wave action.

(6) Provide some form of protection in order to prevent scouring of the channel subgrade at the downstream end of the 12-inch outlet pipe and possible backcutting of the embankment and/or lagoon dike.

(7) Remove trees in the channel at the downstream end of the 12-inch outlet pipe that will obstruct flow in the channel that can result in flooding of the area adjacent to the channel.

(8) Provide maintenance of all areas of the dam and spillway on a regularly scheduled basis in order to insure features of being in satisfactory operational condition.

(9) A detailed inspection of the dam should be instituted on a regular basis by an engineer experienced in the design and construction of dams. It is also recommended, for future reference, that records be kept of all inspections made and remedial measures taken.



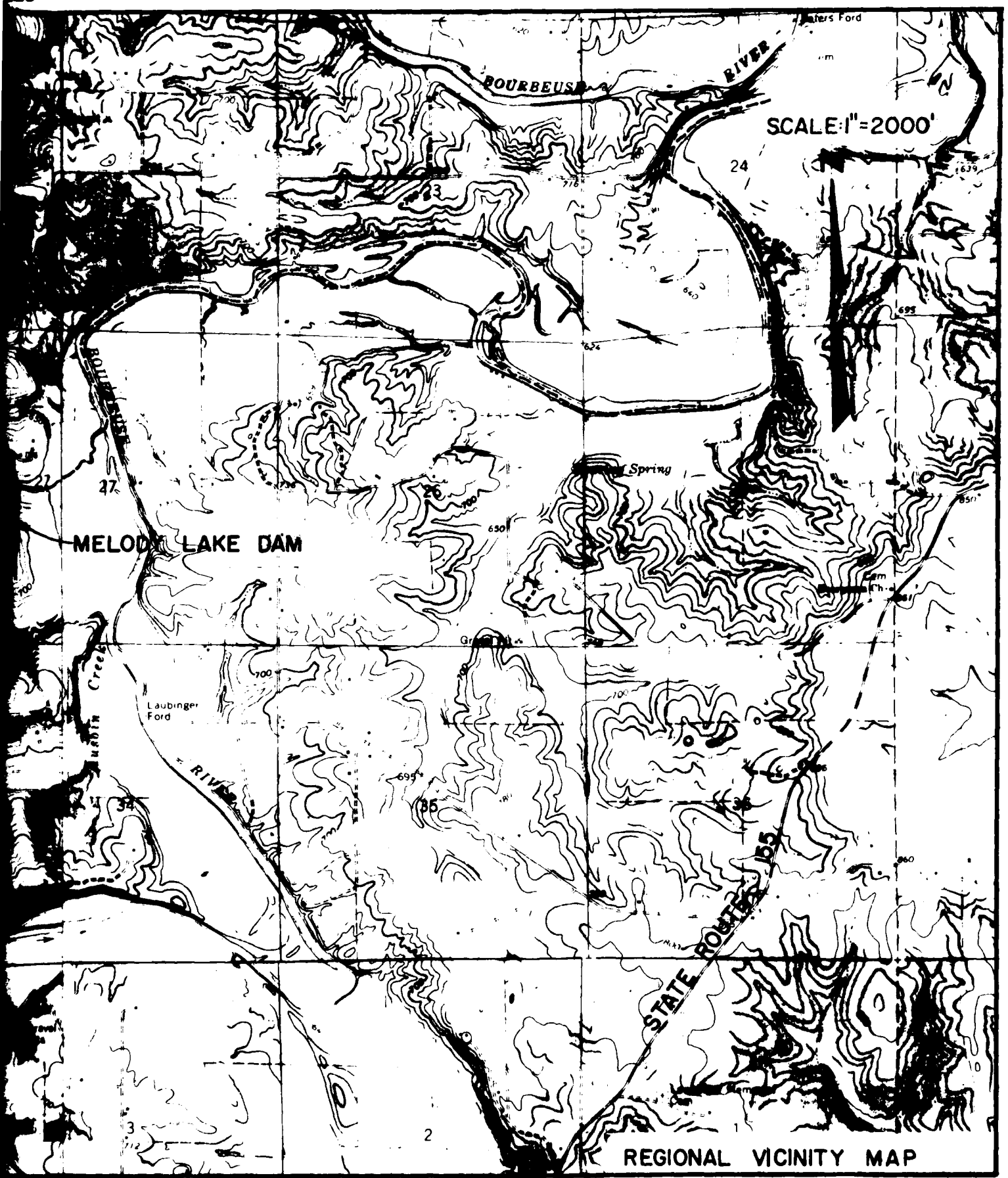


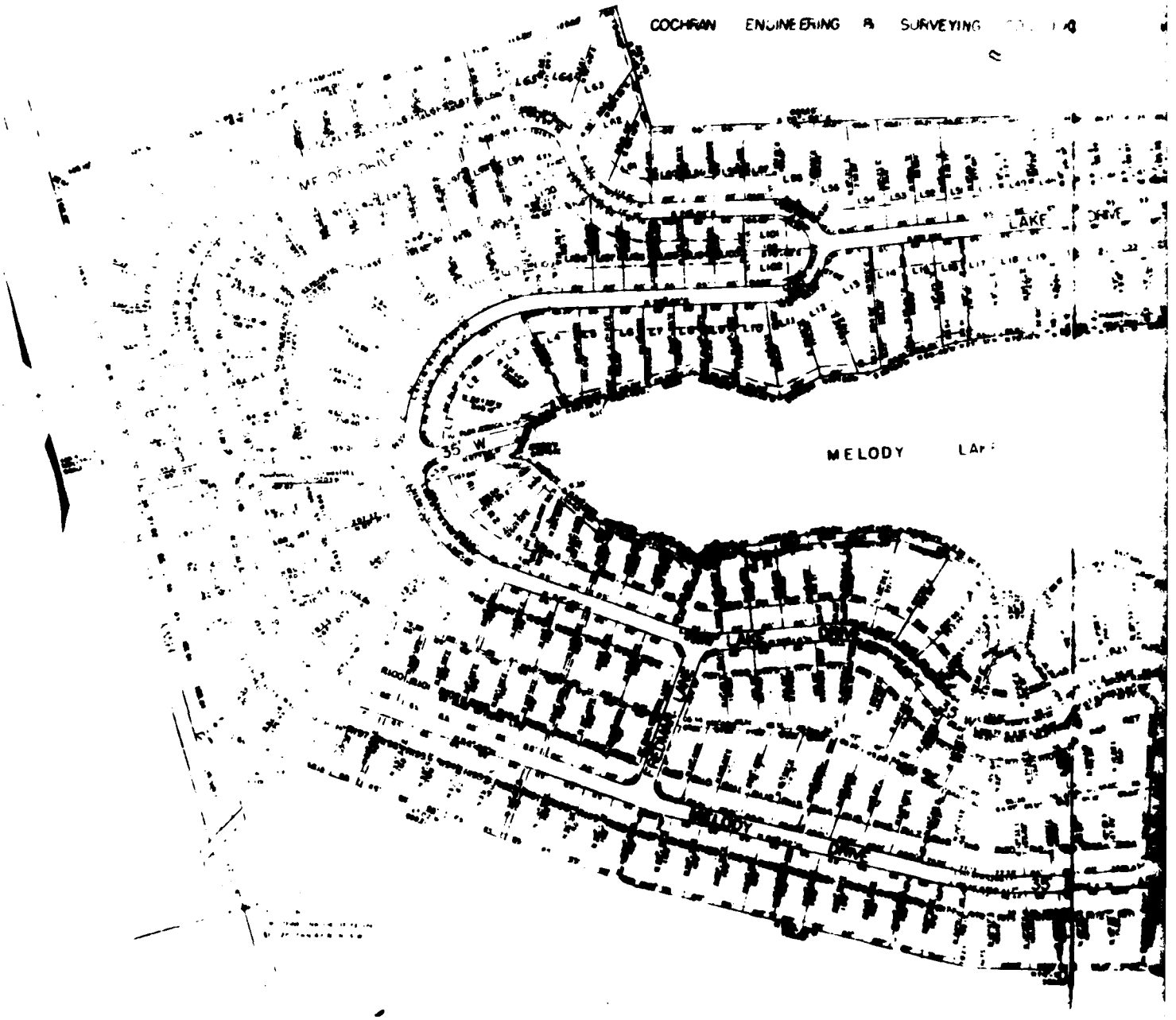
PLATE 1

MELODY PLACE

A SUBDIVISION CONSISTING OF PART OF THE SW 1/4 & PART OF THE [illegible] OF THE [illegible]

[illegible] OF THE NW 1/4, & PART OF THE SW 1/4 OF THE [illegible]

COCHRAN ENGINEERING & SURVEYING [illegible]

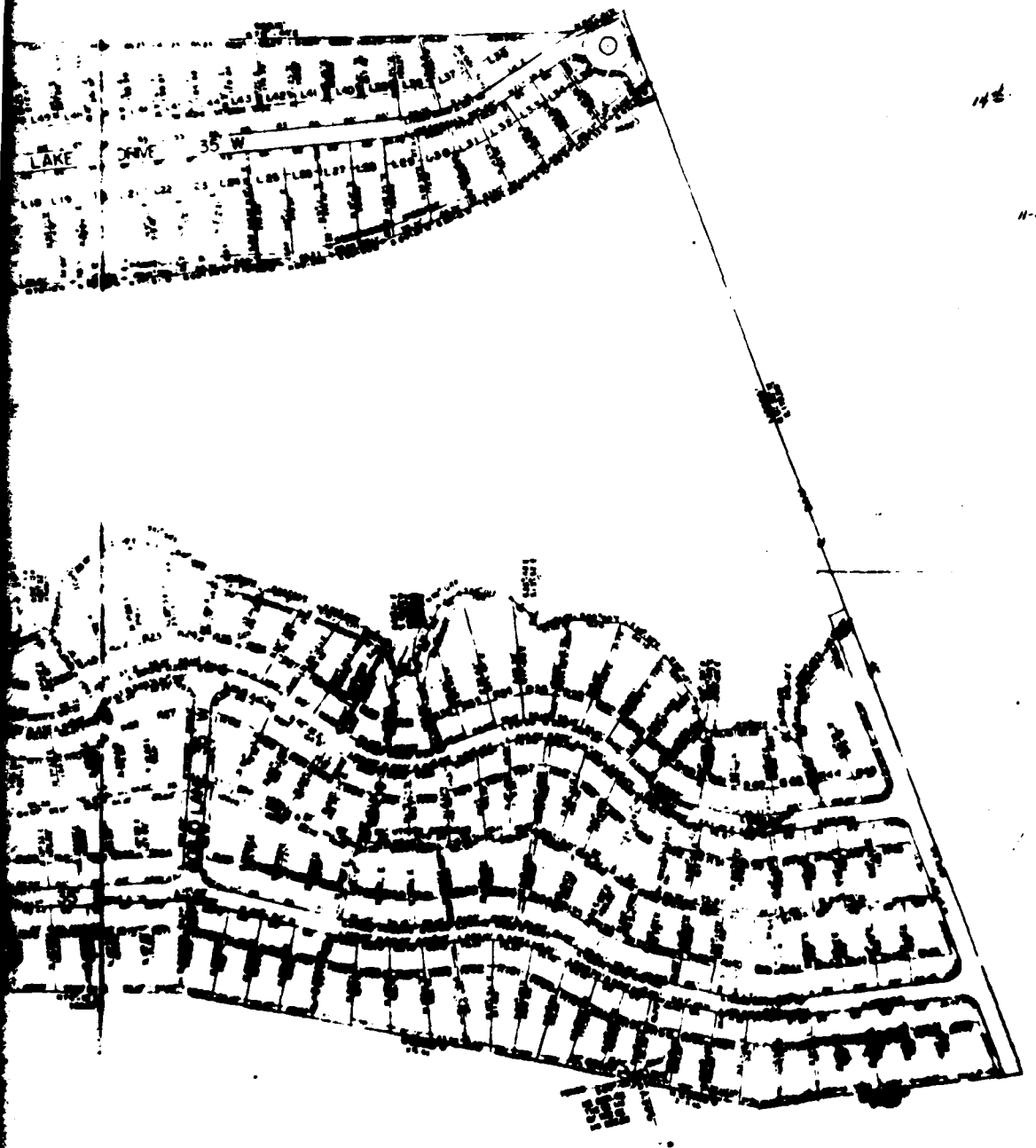


SYMBOLS

SUBDIVISION

OF THE [illegible] PART OF THE NW 1/4 & PART OF THE NE 1/4 OF THE SE 1/4, SEC 28 &
[illegible] 1/4, SEC 27, ALL IN TWN 42 N, R 3 W OF THE 5TH P.M. FRANKLIN COUNTY, MISSOURI

CO. [illegible] WASHINGTON, MISSOURI



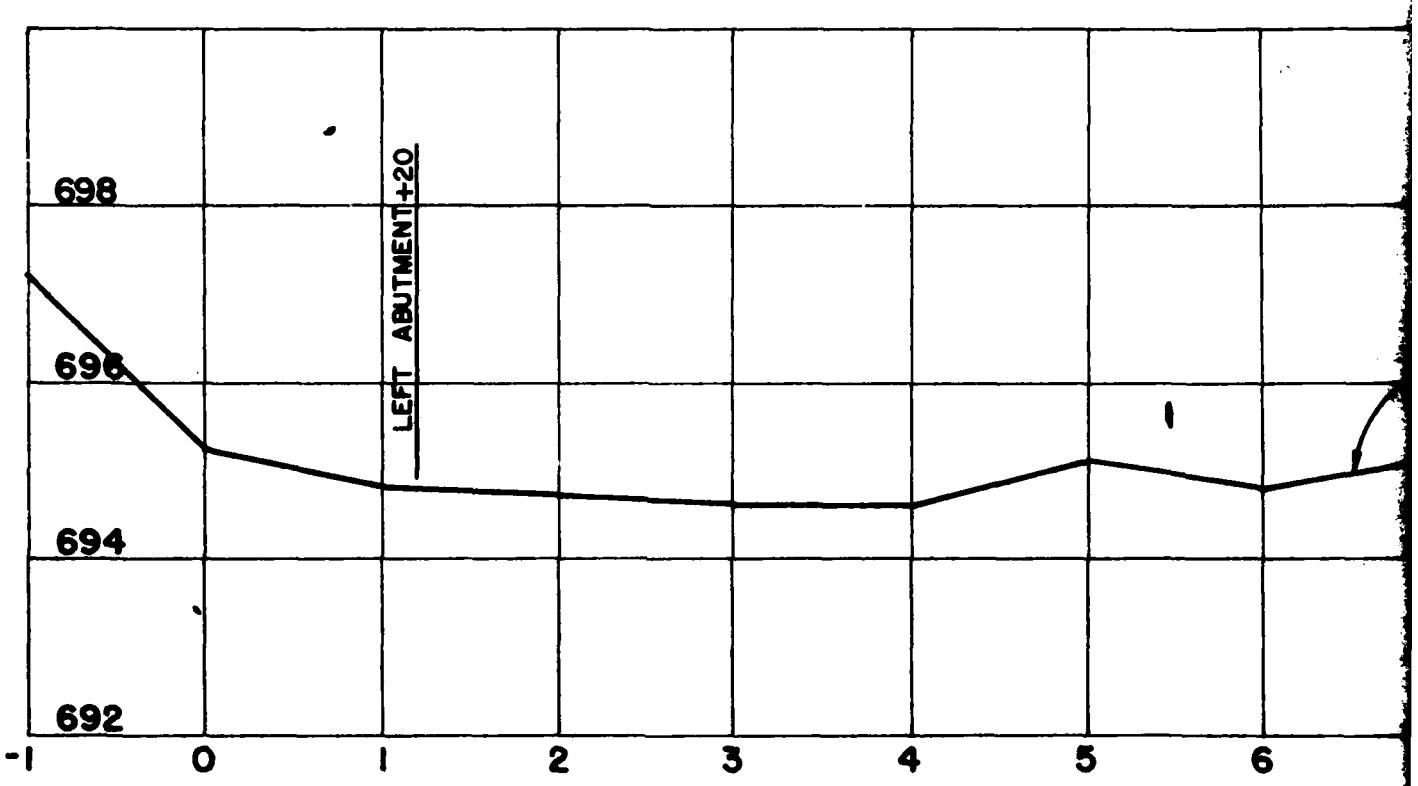
14 May

11-4-1987 Charles E. Hammond

SUBDIVISION PLAT

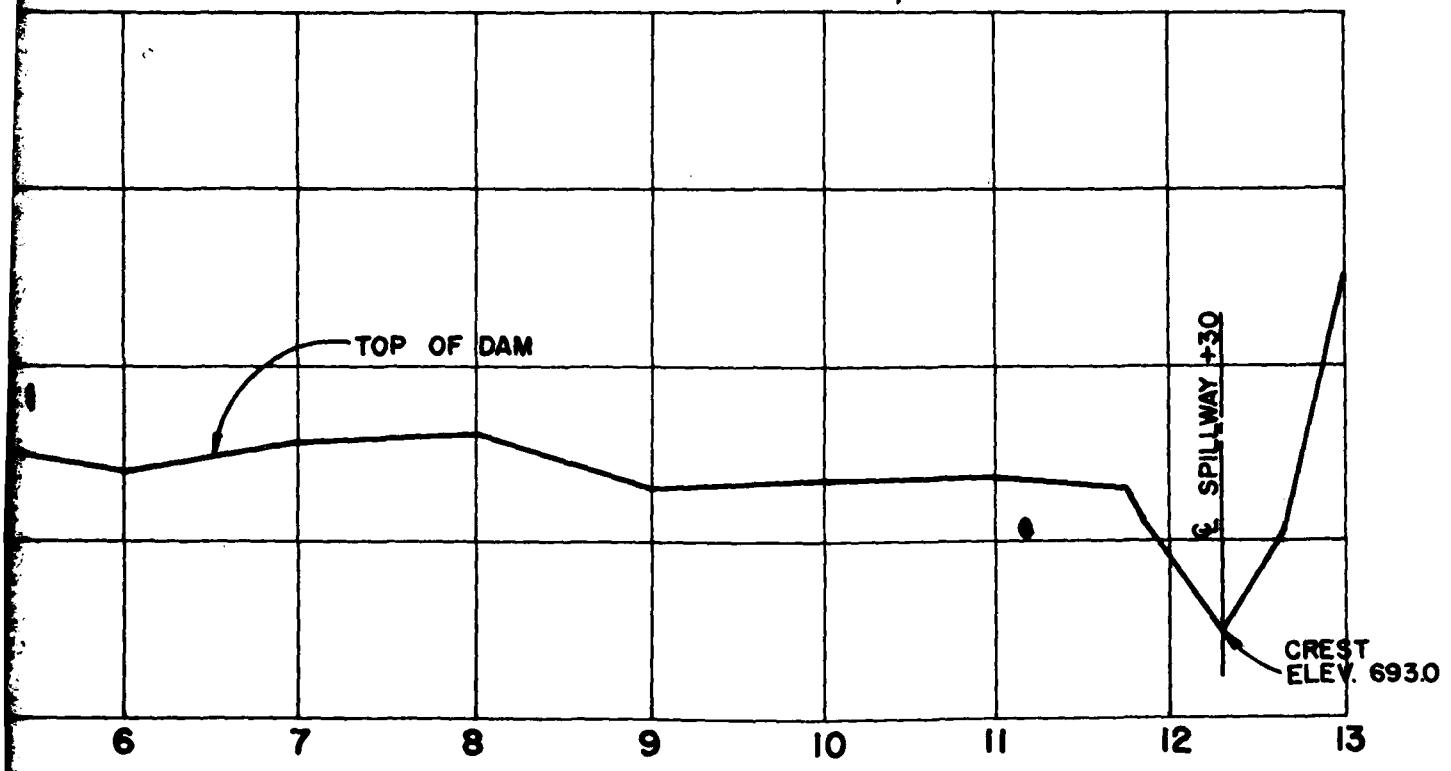
PLATE 2

12



PROFILE DAM ℄

SCALES: 1"=2'V., 1"=100'H.



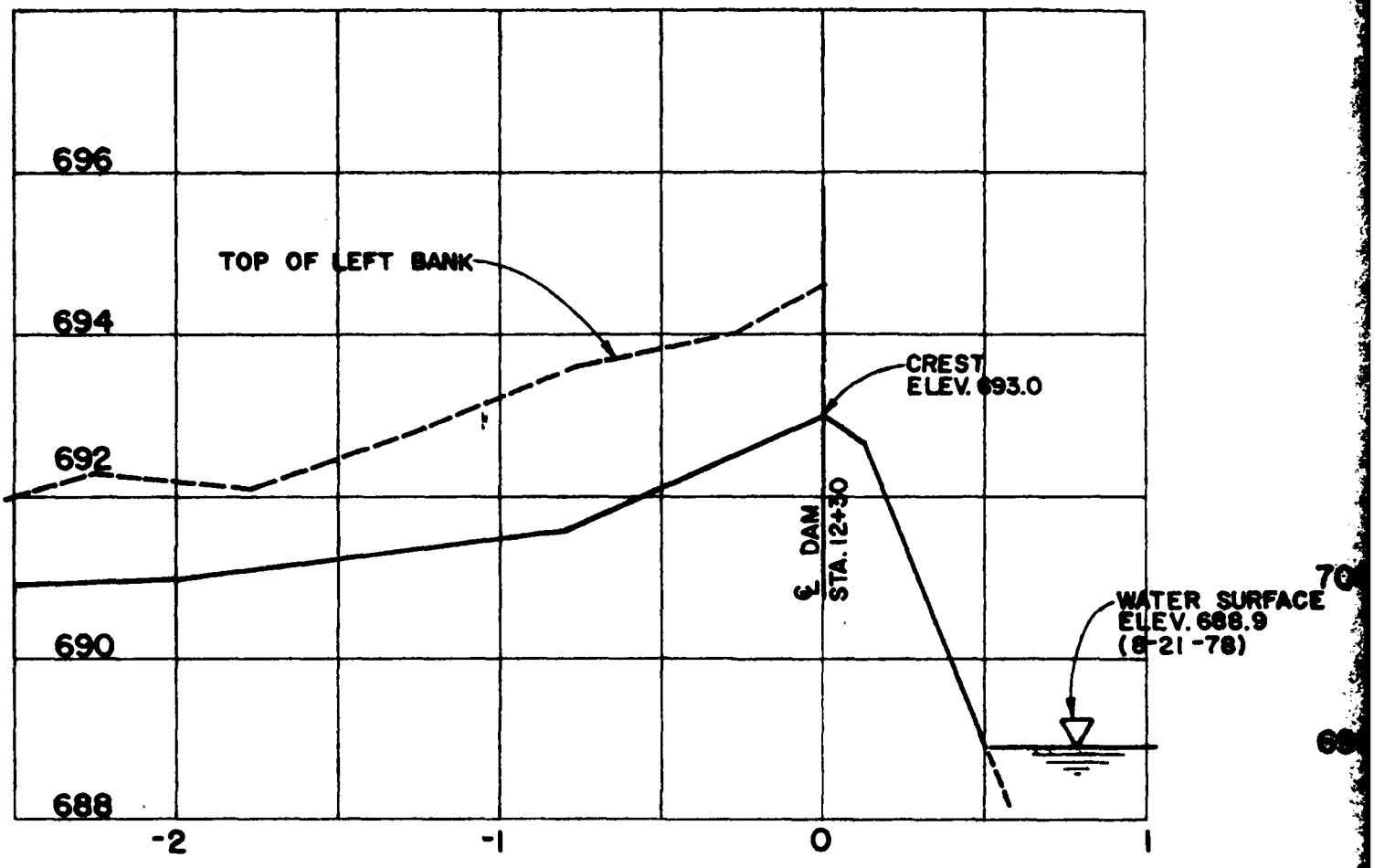
E DAM ℄

=2'V., 1"=100'H.

MELODY LAKE

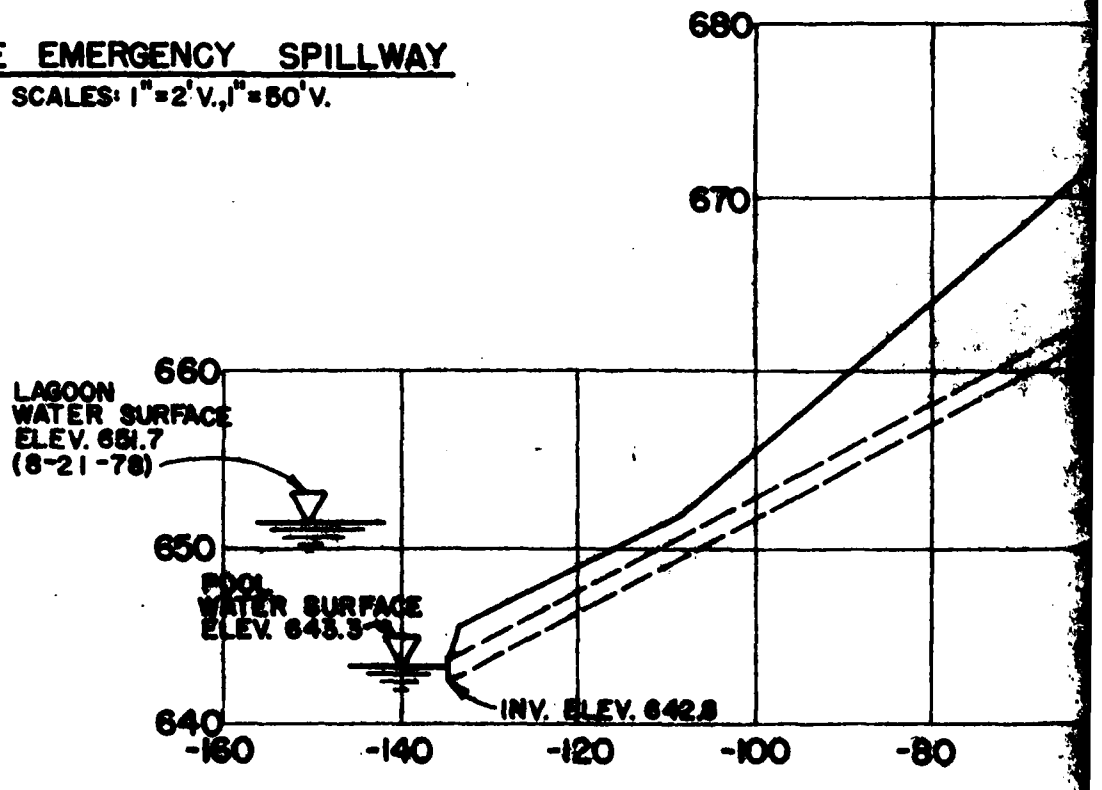
DAM PROFILE

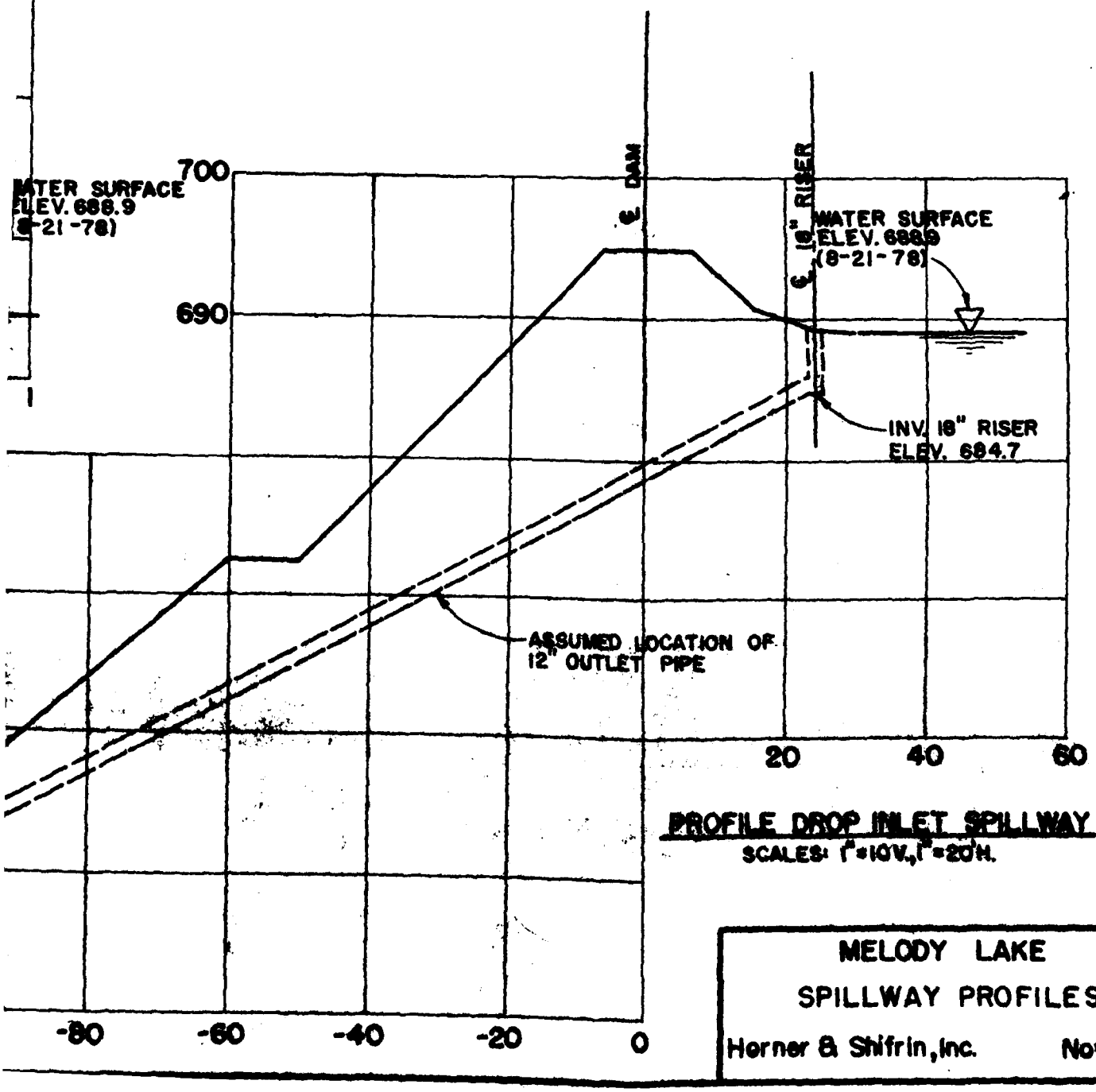
Horner & Shifrin, Inc. Nov. 1978



PROFILE EMERGENCY SPILLWAY

SCALES: 1"=2' V., 1"=50' V.





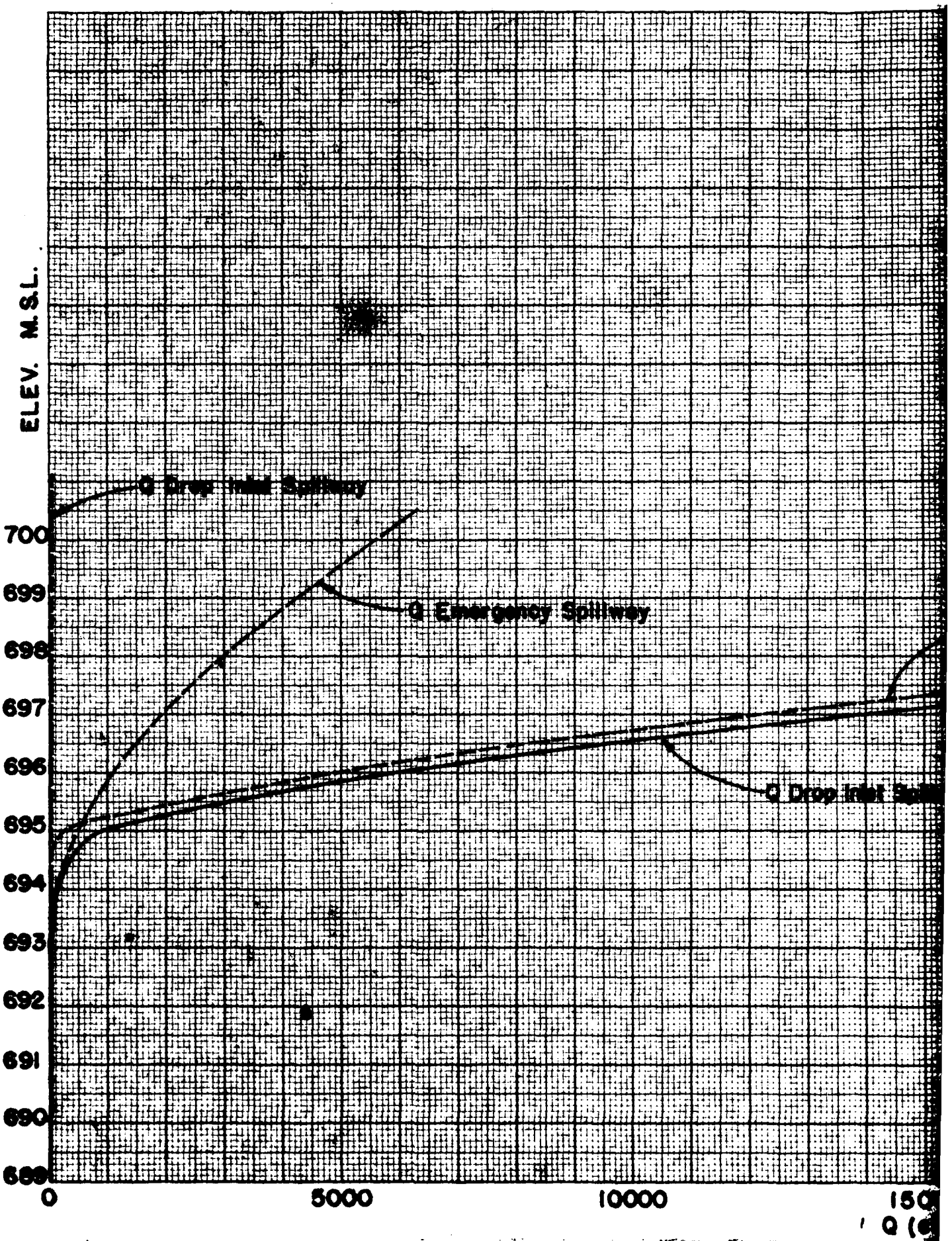
PROFILE DROP INLET SPILLWAY

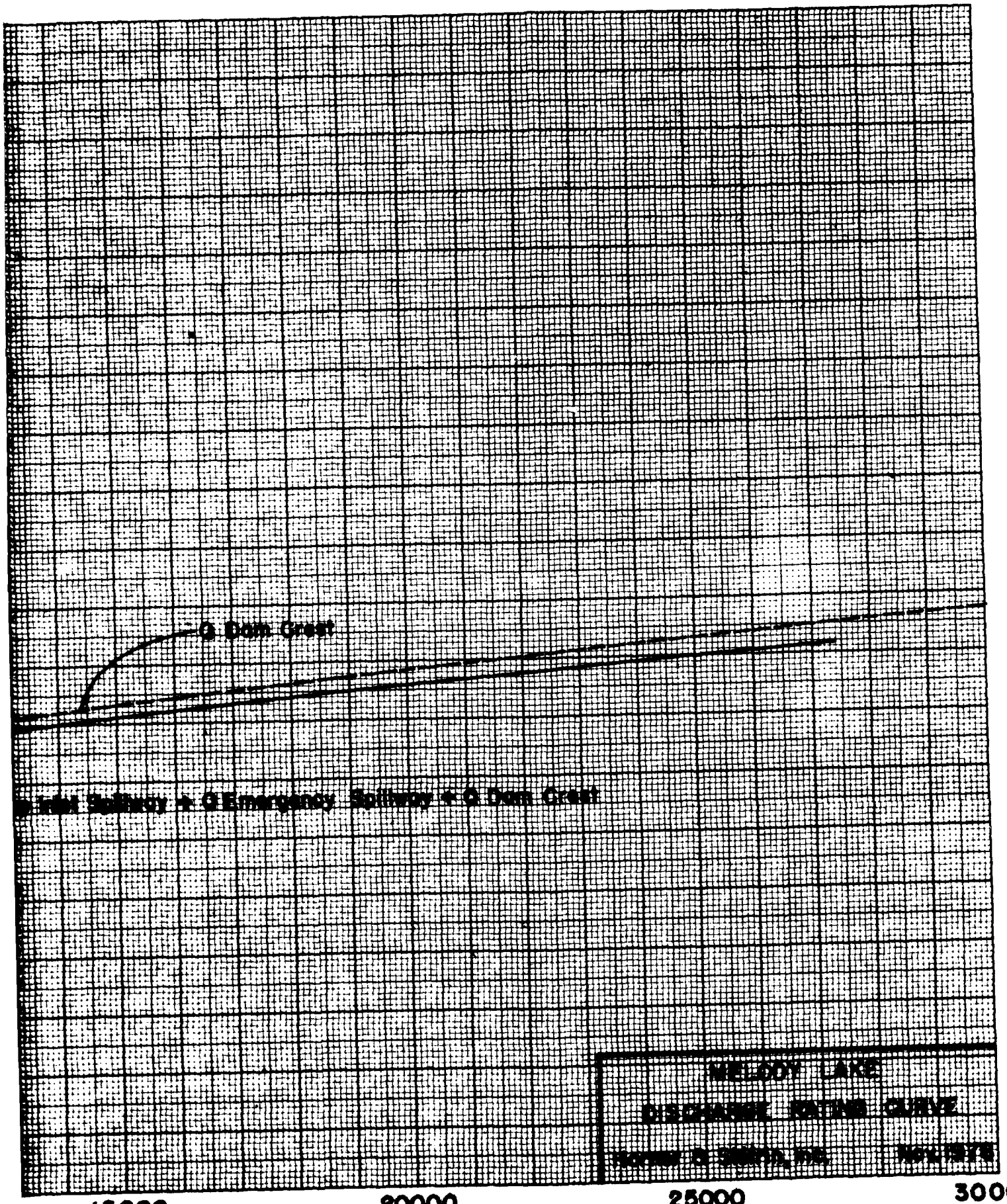
SCALES: 1"=10'V., 1"=20'H.

MELODY LAKE

SPILLWAY PROFILES

Horner & Shifrin, Inc. Nov. 1978


ELEV. M.S.L.
Q Drop Inlet Spillway
Q Emergency Spillway
Q Drop Inlet Spill
700
699
698
697
696
695
694
693
692
691
690
689
0
5000
10000
150
Q (c


Q Dam Crest
Q Inlet Spillway + Q Emergency Spillway + Q Dam Crest
MELODY LAKE
DISCHARGE RATING CURVE
15000
20000
25000
30000
Q (cfs)

2

PLATE 5

MELODY LAKE
PMF INFLOW & OUTFLOW
HYDROGRAPHS

Horner & Shifrin, Inc. Nov. 1978

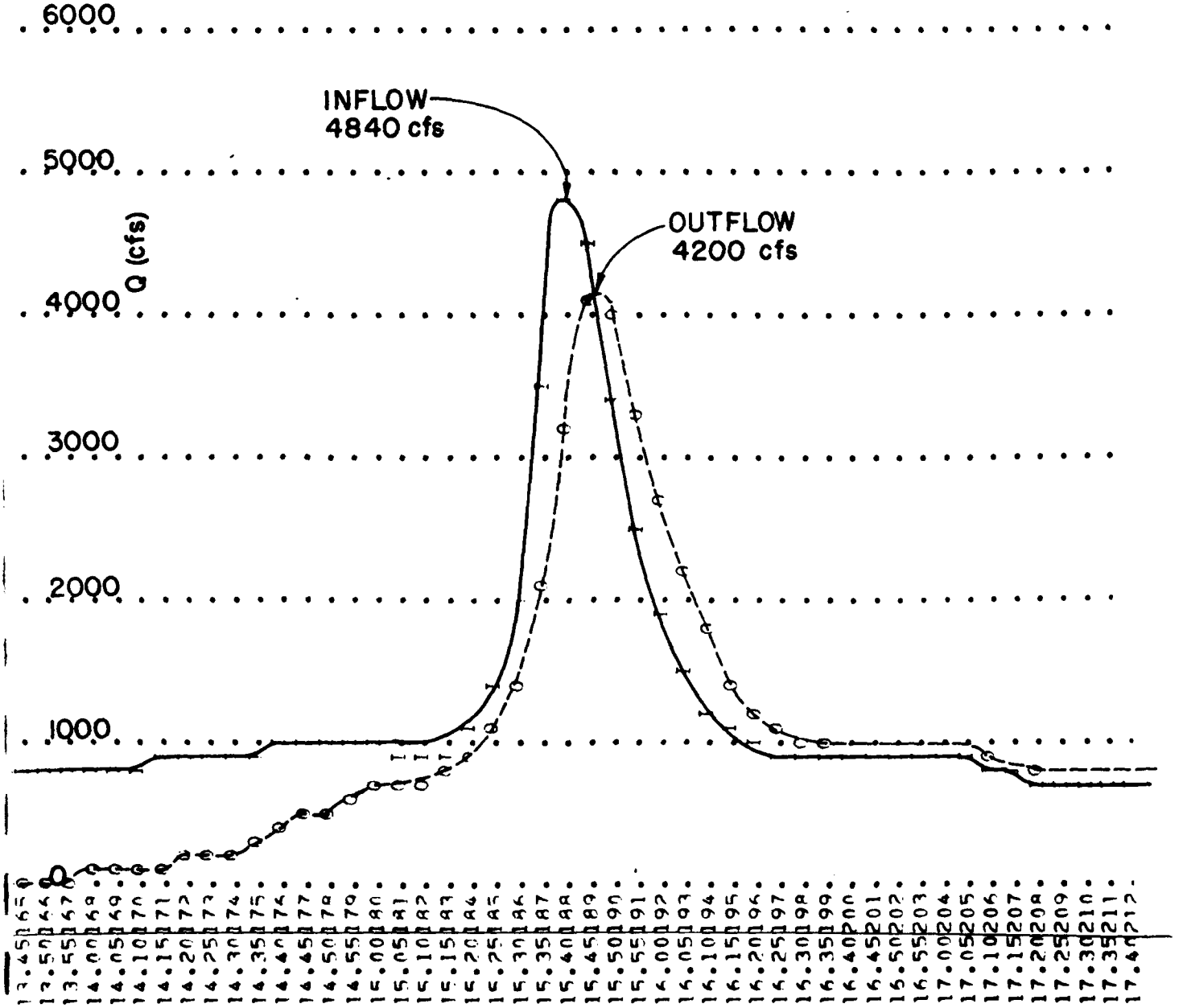
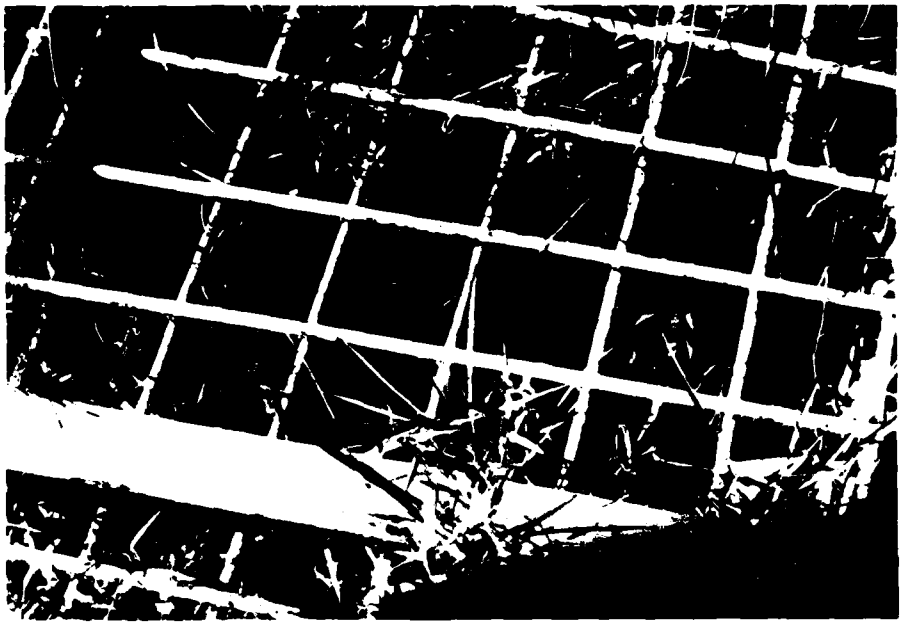


PLATE 6

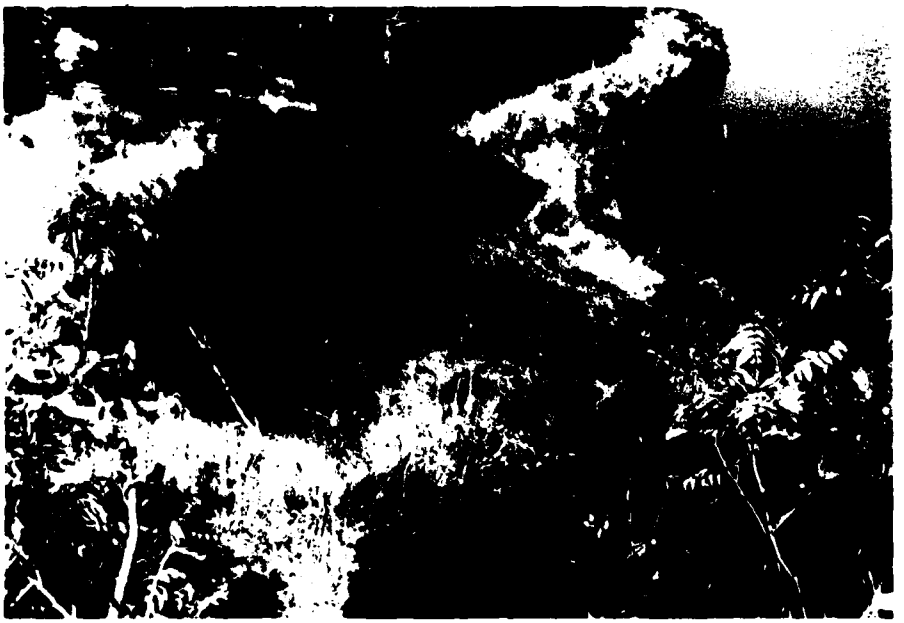
APPENDIX

NO. 1: CREST AND UPSTREAM FACE OF DAM

NO. 2: DOWNSTREAM FACE OF DAM

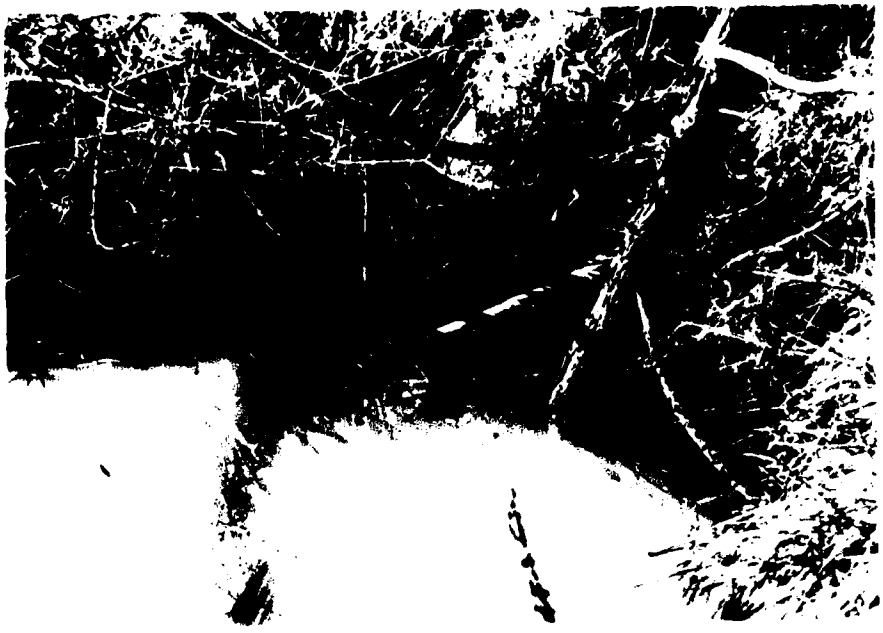


NO. 3: 18-INCH DROP INLET SPILLWAY



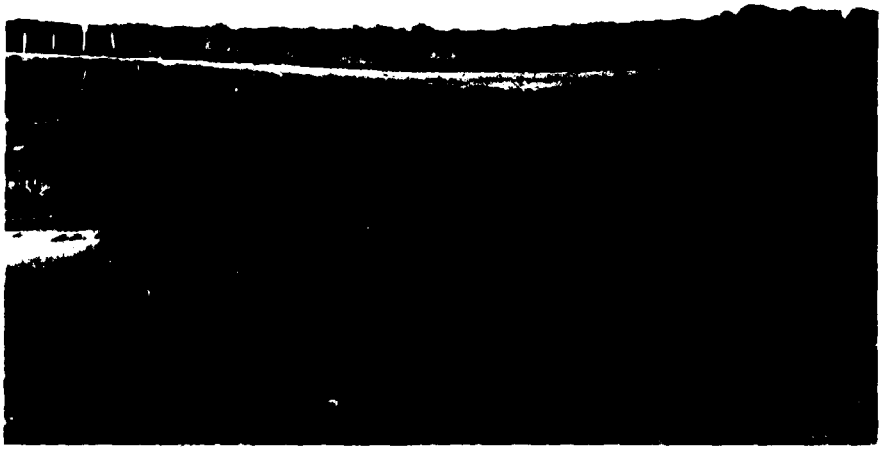
NO. 4: DOWNSTREAM CHANNEL* AT 12-INCH OUTLET PIPE

* The channel follows the downstream slope of the sewage lagoon.



NO. 5: 12-INCH OUTLET PIPE

NO. 6: CATTAILS AT DOWNSTREAM TOE OF SLOPE



NO. 7: LAKE BANK AT EMERGENCY SPILLWAY

NO. 8: OUTLET CHANNEL FOR EMERGENCY SPILLWAY

HYDROLOGIC COMPUTATIONS

1. The HEC-1 Dam Safety Version (July 1978) program was used to develop inflow and outflow hydrographs and dam overtopping analyses, with hydrologic inputs as follows:

a. Probable maximum precipitation (200 sq. mile, 24-hour value equals 25.5 inches) from Hydrometeorological Report No. 33. One hundred year frequency (point precipitation, 24-hour value equals 7.23 inches) from U.S. Weather Bureau Technical Paper No. 40.

b. Drainage area = 0.38 square miles
= 243 acres

c. SCS parameters
Lag time = 0.15 hours
Soil type CN = 91 (Soil Type C, AMC III)

2. The drop inlet spillway release rates were based on the sharp-crested weir equation and limited, where applicable, by the capacity of the 12-inch outlet pipe.

a. Weir flow

$Q = CLH^{\frac{3}{2}}$ (C = 3.3 for drop inlet crest, L = 4.7 feet for 18-inch diameter riser) where H is the head on the weir crest.

b. Pipe flow

Capacity pipe flow was based on friction slope from Manning formula

$$Q = \frac{1.486}{n} Ar^{\frac{2}{3}} S^{\frac{1}{2}}$$

Plus entrance and exit losses = $K \frac{v^2}{2g}$ and n = .013, k = 1.5

3. The emergency spillway section consists of a broad-crested, approximately dish-shaped excavated earth section for which conventional weir formulas do not apply.

Spillway release rates were determined as follows:

a. Spillway crest section properties (area, a and top width, t) were computed for various depths, d.

b. It was assumed that flow over the spillway crest would occur at critical depth. Flow at critical depth (Q_c) was computed as $Q_c = (\frac{a^3}{t} g)^{0.5}$ for the various depth, d.

Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.

c. Static lake levels corresponding to the various Q_c values passing over the spillway were computed as critical depths plus critical velocity head ($d_c + H_{vc}$), and the relationship between lake level and spillway discharge was thus obtained. The procedure neglects the minor insignificant friction losses across the length of the spillway.

4. The profile of the dam crest is irregular and flow over the dam crest cannot be determined by conventional weir formulas. Flow quantities overtopping the dam crest were computed as described in the preceding paragraph and corresponding flow over the dam and spillways for given elevations were added to obtain the combined outflow rating curve for the dam and spillways. This rating curve is shown on Plate 5. The inflow-outflow hydrographs for the PMF are shown on Plate 6.

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
**********
    1                A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
    2                A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF MELODY LAKE DAM
    3                A3       RATIOS OF PMF ROUTED THROUGH RESERVOIR
    4                B     288        0        5       -0       -0       -0       -0       -0       -0       -0
    5                B1      5
    6                J       1        3        1
    7                J1   0.47     0.50     1.00
    8                K       0   INFLOW                                    3        1
    9                K1        INFLOW HYDROGRAPH
   10                M       1        2     0.38                          1.0                         1
   11                P       0     25.5      102      120      130
   12                T                                                              -1      -91
   13                W2             0.15
   14                X    -1.0     -.10      2.0
   15                K       1      DAM                          2        3        1
   16                K1        RESERVOIR ROUTING BY MODIFIED PULS
   17                Y                                       1        1
   18                Y1                                                     504.5       -1
   19                Y4     689    689.6      690    690.5      691      692      693    693.6      694    694.5
   20                Y4     695    695.5      696      697      698      699
   21                Y5       0        7        8       10       12       15       17       44      120      250
   22                Y5     710     2810     5600    13820    24260    36240
   23                SA       0     34.4     38.6     45.9     64.3
   24                SE     645      689      690      700      710
   25                SS     689
   26                SD   694.6
   27                K       99
```

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
**********
    1                 A1       ANALYSIS OF DAM OVERTOPPING USING 100 YR FLOOD
    2                 A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF MELODY LAKE DAM
    3                 A3       100 YR FLOOD ROUTED THROUGH RESERVOIR
    4                 B    288         0         5        -0        -0        -0        -0        -0        -0        -0
    5                 B1     5
    6                 J      1         1         1
    7                 J1   1.0
    8                 K      0  INFLOW                                          3         1
    9                 K1       INFLOW HYDROGRAPH
   10                 M      0         2     0.38                              1.0                             1
   11                 O    288
   12                 O1  .007     .007      .007      .007      .007      .007      .007      .007      .007      .007
   13                 O1  .007     .007      .007      .007      .007      .007      .007      .007      .007      .007
   14                 O1  .007     .007      .007      .007      .007      .007      .007      .007      .007      .007
   15                 O1  .007     .007      .007      .007      .007      .007      .007      .007      .007      .007
   16                 O1  .007     .007      .007      .007      .007      .007      .007      .007      .007      .007
   17                 O1  .007     .007      .007      .007      .007      .007      .007      .007      .007      .007
   18                 O1  .007     .007      .007      .007      .007      .007      .007      .007      .007      .007
   19                 O1  .007     .007      .014      .014      .014      .014      .014      .014      .014      .014
   20                 O1  .014     .014      .014      .014      .014      .014      .014      .014      .014      .014
   21                 O1  .014     .014      .014      .014      .014      .014      .014      .014      .014      .014
   22                 O1  .014     .014      .014      .014      .014      .014      .014      .014      .022      .022
   23                 O1  .022     .022      .022      .022      .022      .022      .022      .022      .022      .022
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   25                 O1  .031     .031      .061      .061      .061      .061      .061      .061      .132      .132
   26                 O1  .132     .253      .253      .555      .830      .385      .253      .132      .132      .132
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   28                 O1  .031     .031      .022      .022      .022      .022      .022      .022      .022      .022
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   31                 O1  .014     .014      .014      .014      .014      .014      .014      .014      .014      .014
   32                 O1  .014     .014      .014      .014      .014      .014      .014      .014      .014      .014
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   37                 O1  .007     .007      .007      .007      .007      .007      .007      .007      .007      .007
   38                 O1  .007     .007      .007      .007      .007      .007      .007      .007      .007      .007
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38    O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
39    O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
40    O1   .007    .007    .007    .007    .007    .007    .007    .007
41    T                                                     -1      -91
42    W2         0.15
43    X   -1.0    -.10    2.0
44    K     1     DAM                     2       3       1
45    K1        RESERVOIR ROUTING BY MODIFIED PULS
46    Y                                 1       1
47    Y1                                                  504.5    -1
48    Y4   689    689.6   690     690.5   691     692     693     693.6   694     694.5
49    Y4   695    695.5   696     697     698     699
50    Y5     0       7     8      10      12      15      17      44      120     250
```



```
51    Y5   710     2810    5600    13820   24260   36240
52    $A     0     34.4    38.6    45.9    64.3
53    $E   645     689     690     700     710
54    $$   689
55    $D 694.6
56    K     99
```

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	689.00	689.00	694.60
STORAGE	504.	505.	726.
OUTFLOW	0.	0.	342.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.47	694.64	.04	728.	375.	1.25	17.17	0.00
.50	694.71	.11	731.	443.	2.08	17.00	0.00
1.00	695.73	1.13	774.	4119.	4.58	15.75	0.00